WHAT IS CLAIMED IS:

1. A voltage-controlled oscillator comprising:

a resonator including first and second output terminals, for generating complementary oscillating AC signals output from the first and second output terminals, respectively;

an amplification unit for maintaining upper peak levels of waveforms of the signals output from the first and second output terminals at a first electric potential and maintaining lower peak levels of the waveforms at a second electric potential lower than the first electric potential; and

a power supply circuit for applying at least one of the first electric potential and the second electric potential to the amplification unit,

wherein the capacitance of the resonator is capable of being varied continuously and also stepwisely, and wherein when the capacitance of the resonator is varied stepwisely, at least one of the first electric potential and the second electric potential is varied stepwisely such that the difference between the first electric potential and the second electric potential increases with increasing capacitance of the resonator.

2. A voltage-controlled oscillator according to claim 1, wherein

the resonator includes

an inductor connected between the first and second output terminals;

a variable capacitance element connected in parallel with the inductor;

one or more capacitor pairs, one electrode of each of capacitors of each capacitor pair being connected with the first or second output terminal; and

one or more first switches to which one ore more control signals are applied, each first switch serving to switch the connection of a corresponding capacitor pair in accordance with a control signal applied thereto between a state in which a third electric potential is applied to the other electrode of each of capacitors of the capacitor pair and a state in which the other electrode of each of capacitors of the capacitor pair is in a floating state; and

the power supply circuit includes

one or more second switches; and

a current mirror circuit,

the one or more second switches being connected in parallel with each other, one terminal of each of the second switches being applied with a fourth electric potential, the second switches being controlled in accordance with said one or more control signals applied thereto such that the second switches connect the one terminal of the second switches to the other terminal thereof when the third electric potential is applied to the other electrode of each capacitor of the capacitor pair by said first switches,

the current mirror circuit being disposed between a first node and a second node or between a third node and a fourth node, the first node being applied with a fifth

electric potential higher than the first electric potential, the second node is located in the amplification unit and is applied with the first electric potential, the third node is applied with a sixth electric potential lower than the second electric potential, the fourth node is located in the amplification unit and is applied with the second electric potential, the current mirror circuit is connected with the other electrode of each second switch, and the current mirror circuit serves to pass, between the first node and the second node, a current proportional to the total current flowing through the one or more second switches thereby applying the first electric potential to the amplification unit or to pass, between the third node and the fourth node, a current proportional to the total current flowing through the one or more second switches thereby applying the second electric potential to the amplification unit.

3. A voltage-controlled oscillator according to claim 2, wherein

the first and second switches are N-channel transistors; and

when a high-level voltage is applied as a control signal to one of the first switches and the corresponding one of the second switches, the one of the first switches causes the third electric potential to be applied to the other electrode of each capacitor of a corresponding capacitor pair, and the one of the second switches turns on such that one electrode thereof is connected with the other electrode thereof, while when a low-level voltage is applied

as a control signal to one of the first switches and the corresponding one of the second switches, the one of the first switches causes the other electrode of each capacitor of a corresponding capacitor pair to be brought into a floating state, and the one of the second switches turns off such that one electrode thereof and the other electrode thereof are isolated from each other.

4. A voltage-controlled oscillator according to claim 2, wherein

the one or more second switches being connected in parallel with each other, one terminal of each of the second switches being applied with a fourth electric potential, the second switches being controlled in accordance with the one or more control signals applied thereto such that when, in accordance with a control signal, the first switch switches the connection of the capacitor pair corresponding to the first switch into the state in which the third electric potential is applied to the other electrode of each capacitor of the capacitor pair, a corresponding second switch to which the same control signal is applied turns on such that one terminal of the second switch is connected with the other terminal thereof, the current mirror circuit being disposed between a first node and a second node or between a third node and a fourth node, the first node being applied with a fifth electric potential higher than the first electric potential, the second node being located in the amplification unit and being applied with the first electric potential, the third node being applied with a

sixth electric potential lower than the second electric potential, the fourth node being located in the amplification unit and being applied with the second electric potential, the current mirror circuit being connected with the other electrode of each second switch, the current mirror circuit serving to pass, between first node and the second node, a current proportional to the total current flowing through the one or more second switches thereby applying the first electric potential to the amplification unit or to pass, between the third node and the fourth node, a current proportional to the total current flowing through the one or more second switches thereby applying the second electric potential to the amplification unit.

the first and second switches are P-channel transistors; and

when a low-level voltage is applied as a control signal to one of the first switches and the corresponding one of the second switches, the one of the first switches causes the third electric potential to be applied to the other electrode of each capacitor of a corresponding capacitor pair, and the one of the second switches turns on such that one electrode thereof is connected with the other electrode thereof, while when a high-level voltage is applied as a control signal to one of the first switches and the corresponding one of the second switches, the one of the first switches causes the third electric potential to be applied to the other electrode of each capacitor of a

corresponding capacitor pair, and the one of the second switches turns on such that one electrode thereof is connected with the other electrode thereof.

5. A voltage-controlled oscillator according to claim 2, wherein the current mirror circuit includes a first P-channel transistor the drain and the source of which are connected with the first node and the second node, respectively, or with the fourth node and the third node, respectively; and a second P-channel transistor the drain of which is applied with a seventh electric potential higher than the fourth electric potential, the source of which is connected with the other electrode of each second switch, and the gate of which is connected with the gate of the first P-channel transistor and also with the other electrode of each second switch.

6. A voltage-controlled oscillator according to claim 2, wherein the current mirror circuit includes a first N-channel transistor the drain and the source of which are connected with the first node and the second node, respectively, or with the fourth node and the third node, respectively; and a second N-channel transistor the source of which is applied with an eighth electric potential lower than the fourth electric potential, the drain of which is connected with the other terminal of each second switch, and gate of which is connected with the gate of the first N-channel transistor and also with the other electrode of each second switch.

7. A voltage-controlled oscillator according to

claim 2, wherein the variable capacitance element is a varactor to which another control voltage is applied and whose capacitance varies depending on the applied control voltage.

8. A voltage-controlled oscillator according to of claim 2, wherein the inductor is a spiral inductor formed on a substrate.

9. A voltage-controlled oscillator according to claim 2, wherein the fifth voltage is a power supply voltage, and the sixth voltage is a ground voltage.

10. A voltage-controlled oscillator according to claim 1, wherein the amplification unit includes a third P-channel transistor, a fourth P-channel transistor, a third N-channel transistor, and a fourth N-channel transistor, the drain of the third P-channel transistor being applied with the first electric potential, the source of the third P-channel transistor being connected with the first output terminal, the gate of the third P-channel transistor being connected with the second output terminal, the drain of the fourth P-channel transistor being applied with the first electric potential, the source of the fourth P-channel transistor being connected with the second output terminal, the gate of the fourth P-channel transistor being connected with the first output terminal, the source of the third N-channel transistor being applied with the second electric potential, the drain of the third N-channel transistor being connected with the first output terminal, the gate of the third N-channel transistor being connected with the second

output terminal, the source of the fourth N-channel transistor being applied with the second electric potential, the drain of the fourth N-channel transistor being connected with the second output terminal, the gate of the fourth N-channel transistor being connected with the first output terminal.

11. A voltage-controlled oscillator according to claim 1, wherein the voltage-controlled oscillator is a local oscillator in a phase locked loop.